A New Combination in *Pediomelum* and a New Genus, *Ladeania*, from Western North America (Fabaceae, Psoraleeae)

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Abstract. *Psoralidium tenuiflorum* (Pursh) Rydberg, the type of *Psoralidium* Rydberg, is transferred to *Pediomelum* Rydberg requiring a new combination, *Pediomelum tenuiflorum* (Pursh) A. N. Egan in tribe Psoraleeae Lowe (Fabaceae/Leguminosae). Previously published evidence on phylogenetic relationships provides a foundation for this combination, as do shared morphological traits such as persistent bracts and an elliptical fruit that falls with the calyx. A new genus, *Ladeania* A. N. Egan & Reveal, is described to accommodate the two remaining species previously in *Psoralidium*: *L. juncea* (Eastwood) A. N. Egan & Reveal and *L. lanceolata* (Pursh) A. N. Egan & Reveal, with the latter designated as the type. *Ladeania* is distinguished by readily deciduous bracts accompanying a calyx that does not enlarge or elongate in fruit, but flares back from the receptacle. A lectotype is designated for *Psoralea floribunda* Nuttall ex Torrey & A. Gray.

Key words: Fabaceae, IUCN Red List, *Ladeania*, Leguminosae, North America, *Pediomelum*, Psoraleeae, *Psoralidium*.

Psoralidium tenuiflorum (Pursh) Rydberg was first collected on the historical expedition of Meriwether Lewis and William Clark on 21 September 1804 at the Big Bend of the Missouri River, which would later become Lyman County, South Dakota, U.S.A. (Moulton, 1987; Reveal et al., 1999). The species is widespread across much of the Great Plains of the United States (The Great Plains Flora Association, 1986). Frederick Pursh (1813) later described it as *Psoralea tenuiflora* Pursh. Since then, the species has experienced a murky taxonomic history. Rydberg (1919) designated *Psoralea tenuiflora* as the type of a new genus, *Psoralidium* Rydberg, wherein he recognized 14 species. Four of Rydberg's species, *Psoralidium floribundum* (Nuttall) Rydberg, *Psoralidium bigelovii* Rydberg, *Psoralidium batesii* Rydberg, and *Psoralidium obtusilobum* (Torrey & A. Gray) Rydberg, were later assigned to synonymy under *Psoralidium tenuiflorum* by Grimes (1990). Both Grimes and Isely (1998) recognized that the variation across this species is great, but with no distinct segregation as to definitively allow specific designation, an ascertainment that the authors of this paper share.

Recently, Egan and Crandall (2008) conducted a comprehensive phylogenetic analysis of North American members of tribe Psoraleeae Lowe, to which *Psoralidium* and *Pediomelum* Rydberg belong. Their study estimated evolutionary relationships within North American Psoraleeae across eight DNA regions: ITS, *Waxy*, *trnS/G*, *trnL/F*, *trnK*, *matK*, *trnD/T*, and *rpoB-trnC*. All analyses therein suggested that *Psoralidium*, as circumscribed by Grimes (1990), was not a natural grouping and that *Psoralidium tenuiflorum* nested well within *Pediomelum*. In addition, both accessions included in their analyses grouped together within a well-supported clade consisting predominately of species ascribed to subgenus *Pediomelum* by Grimes (see Egan & Crandall, 2008: figs. 2, 3).

Grimes (1990) diagnosed *Psoralidium* by its unique calyx morphology that does not enlarge in fruit, but instead flares back and tears along a lateral sinus. While *Psoralidium tenuiflorum* possesses similar calyx morphology, some of its other traits suggest an affinity with *Pediomelum*. The remaining two species that Grimes assigned to *Psoralidium*, *P. lanceolatum* (Pursh) Rydberg and *P. junceum* (Eastwood) Rydberg, possess readily deciduous bracts and globose to subglobose fruits that are deciduous above the receptacle, while *Psoralidium tenuiflorum* has persistent bracts and an elliptical fruit that falls with the calyx, traits more similar to those of *Pediomelum*. In preparation for the forthcoming treatment of Fabaceae for the *Flora of North America*, *Psoralidium tenuiflorum* is transferred from *Psoralidium* to *Pediomelum* on the basis of the above phylogenetic and morphological data.

With the transfer of the type species of *Psoralidium* (Rydberg, 1919), based on *Psoralea tenuiflora* (Pursh, 1813), to *Pediomelum*, the remaining two species assigned to that genus, *Psoralidium junceum* and *Psoralidium lanceolatum*, require a new generic name. We resolve this issue by describing the new genus *Ladeania* A. N. Egan & Reveal with two new combinations: *L. juncea* (Eastwood) A. N. Egan &

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Reveal and *L. lanceolata* (Pursh) A. N. Egan & Reveal, with the latter designated as the type.

Pediomelum tenuiflorum (Pursh) A. N. Egan, comb. nov. Basionym: *Psoralea tenuiflora* Pursh, Fl. Amer. Sept. 2: 475. Dec. 1813. *Lotodes tenuiflorum* (Pursh) Kuntze, Revis. Gen. Pl. 1: 194. 1891, nom. illeg. *Psoralidium tenuiflorum* (Pursh) Rydberg, N. Amer. Fl. 24: 15. 1919. TYPE: U.S.A. South Dakota: Lyman Co., Big Bend of the Missouri River, 21 Sep. 1804, *M. Lewis s.n.* (lectotype, designated by Grimes, 1990: 36, PH-LC 184; duplicates, NY [fragm.], PH-LC 183).

Psoralea floribunda Nuttall ex Torrey & A. Gray, Fl. N. Amer. 1: 300. 1838. *Lotodes floribundum* (Nuttall ex Torrey & A. Gray) Kuntze, Revis. Gen. Pl. 1: 194. 1891, nom. illeg. *Psoralea tenuiflora* var. *floribunda* (Nuttall ex Torrey & A. Gray) Rydberg, Bot. Sem. Univ. Neb. [= Fl. Nebr., Rosales] 21: 55. 1895. *Psoralidium floribundum* (Nuttall ex Torrey & A. Gray) Rydberg, N. Amer. Fl. 24: 15. 1919. TYPE: U.S.A. "Arkansas" [probably southeastern Oklahoma]: Aug. 1819, *T. Nuttall s.n.* (lectotype, designated here, NY [26777]).

The NY specimen of *Psoralea floribunda* was chosen as the lectotype based on the fact that it was annotated by Nuttall, who stated that it was collected in the Arkansas Territory; the sheet also bears a small sketch by Torrey proving that he examined the material. The combination of these factors makes this specimen a good choice for lectotypification of *P. floribunda.*

Distribution and habitat. This species occurs widely across North America, mostly within the Great Plains of the United States, but also in desert shrub and woodlands at 200–1800 m elevation, from Montana east to Minnesota and south to Texas and northern Mexico (see Grimes [1990] and Isely [1998] for comprehensive maps of species distribution).

IUCN Red List category. We suggest that *Pediomelum tenuiflorum* be designated as a taxon of Least Concern (LC) according to the IUCN Red List Categories and Criteria (IUCN, 2001) due to its widespread distribution and presence in both natural and disturbed habitats.

Relationships. Molecular phylogenetic studies place *Pediomelum tenuiflorum* well within the subgenus *Pediomelum* as circumscribed by Grimes (1990). Morphology supports this placement in that *P. tenuiflorum* has a tall, branched habit with a persistent inflorescence, characteristics that distinguish subgenus *Pediomelum* from subgenus *Disarticulatum* J. W. Grimes.

Pediomelum tenuiflorum fits easily into the key for *Pediomelum* provided by Grimes (1990: 58) with the reformatting and addition of a new couplet to his couplet 6:

6a. Calyx 2.5–6 mm to lower tooth; peduncle always greater than 7 mm . . . . . 6′a
6′a. Pedicel in flower 3.5–10 mm long. . . . . *Pediomelum linearifolium*
6′b. Pedicel in flower 1.5–3 mm long. . . . . *Pediomelum tenuiflorum*
6b. Calyx 5.5–19 mm to lower tooth; if as short as 5.5 mm, then peduncle 7 mm or less.

Ladeania A. N. Egan & Reveal, gen. nov. TYPE: *Psoralea lanceolata* Pursh [≡ *Ladeania lanceolata* (Pursh) A. N. Egan & Reveal].

Genus novum quod a *Pediomelo* Rydberg bracteis cito caducis et calyce e receptaculo reflexo sed nec amplificato nec elongato tempore fructificante, a *Rupertia* J. W. Grimes receptaculo complanato (nec tumido) differt.

Plants herbaceous, usually much-branched and glandular, arising from rhizomes or from deep, woody roots. *Stems* usually much-branched basally, mostly sparingly so apically, glabrate or sericeous to densely pubescent throughout or at least basally, occasionally becoming glabrate with age, green, smooth or lightly striate, occasionally distinctly ribbed apically, lowermost portions often with thin, tan to brown cataphylls. *Leaves* palmately compound or pseudopalmate, (1 to)3- to 5-foliate; stipules quickly to tardily deciduous, usually adnate to petiole, rarely connate behind petiole, often modified to form cataphylls at base of stem; petioles not jointed to stem; leaflets petiolulate, persistent or quickly deciduous and sometimes lacking at maturity. *Inflorescence* an indeterminate, dense to interrupted pseudoraceme with (1 to)2(to 3) flowers per node; bracts lanceolate to rhombic, quickly deciduous. *Flowers* pedicellate; calyx with pallid green teeth or green throughout, glandular, sometimes glabrate to sericeous; teeth 5, usually less than half as long as calyx tube, mostly equal in length, the abaxial tooth sometimes slightly longer, flaring back and tearing along a lateral sinus in fruit; corolla papilionaceous, inserted on hypanthium rim, yellowish to purple-blue or dark purple, rarely white; banner reflexed 30°–90°, auriculate or not; wings and keel connate just above claw; wings dorsally lamellate on ventral side with a reflexed, dorsiventral lobe; keel fused apically; stamens diadelphous, the distinct portion of filaments filiform, in 2 series; anthers basifixed (upper series) and dorsifixed (lower series);

ovary 1-ovulate, short stipitate with stipe obscured by swollen hypanthial nectaries; style ± reflexed. *Fruit* an indehiscent, 1-seeded legume, circular, deciduous above receptacle; *seed* round to elliptic, somewhat compressed, brown, smooth.

Etymology. This genus is named in honor of LaDean Egan (1949–), mother of the senior author, in recognition of her steadfast support during numerous field-collecting trips throughout the course of her daughter's study of North American Psoraleeae.

Relationships. Recent molecular phylogenetic work placed *Ladeania* as most closely related to *Rupertia* (Egan & Crandall, 2008). Morphology supports this conclusion in that both are characterized as having deciduous bracts and a fruit that is deciduous above the receptacle; they differ in calyx and leaf morphology as well as in the receptacle being tumid in *Rupertia* and flat in *Ladeania.*

The following key (modified from Grimes, 1990) distinguishes *Ladeania* from other genera of New World Psoraleeae. This key should be inserted in Grimes' key (1990: 16) so as to replace couplets 4 through 8.

4a. Fruit developing an internal wall of sclereids at maturity; calyx not enlarging, elongating, or changing shape during fruiting . . . . . *Hoita*
4b. Fruit not developing an internal wall of sclereids at maturity; calyx changing shape and/or enlarging, elongating during fruiting. 5
5a. Calyx not enlarging or elongating through fruiting, but flaring back widely from receptacle, this accompanied by readily deciduous bracts . . . *Ladeania*
5b. Calyx enlarging or elongating, if only slightly, commonly inflating somewhat; if calyx not enlarging or elongating and flaring back, then accompanied by persistent bracts 6
6a. Pericarp rugose, glabrous (glabrate). . . . . *Orbexilum*
6b. Pericarp not rugose, usually pubescent, rarely glabrate. 7
7a. Bracts persistent; fruit persistent on receptacle . . . . . *Pediomelum*
7b. Bracts deciduous; fruit deciduous above receptacle . . . 8
8a. Receptacle tumid; corolla ochroleucous or yellow . . . . . *Rupertia*
8b. Receptacle flat; corolla blue, purple, or violet . . . . . *Otholobium*

The following key distinguishes between the two species in the genus *Ladeania*:

1a. Mature stems rushlike, leafless or with only a few basal leaves; peduncle 15–40 cm long or more; calyx 3–4 mm long . . . . . *L. juncea*
1b. Mature stems not rushlike, with numerous leaves; peduncle 1–14 cm long; calyx 2–2.5 mm long. . . . . *L. lanceolata*

1. Ladeania lanceolata (Pursh) A. N. Egan & Reveal, comb. nov. Basionym: *Psoralea lanceolata* Pursh, Fl. Amer. Sept. 475. 1814 [actual date, Dec. 1813]. *Psoralidium lanceolatum* (Pursh) Rydberg, N. Amer. Fl. 24: 13. 1919. TYPE. U.S.A. Along the Missouri River, 1811, *T. Nuttall s.n.* (lectotype, designated by Grimes, 1989: 22, PH-LC 182; duplicate, NY [PH-LC fragm.]). Figure 1.

Although traditionally the type was considered to have been collected by Meriwether Lewis in 1804, Reveal et al. (1999: 42) showed that this sheet could only have been gathered by Thomas Nuttall in 1811. If indeed Pursh had *Lewis 42* in hand prior to 1813, that specimen is now lost and Grimes' typification is an effective lectotypification (Barneby, 1989). This species is quite variable among a number of its morphological characters across its wide distribution (see Fig. 1). While some geographic trends exist within the species, most traits are continuous with intermediates seemingly disbanding any coherency of morphologically diagnostic traits. In agreement with Grimes (1990) and Isely (1998), we abstain from recognizing any varieties across the range of this species. Specific and varietal nomenclature is synonymized by Grimes (1990).

Distribution and habitat. The species is widespread across the western Great Plains and throughout the Intermountain West in the United States, from Washington east to North Dakota, south to the Texas Panhandle and west to Arizona. It is also found in adjacent Canada. It flourishes in sandy soils, but is found less often on semistabilized soils of sagebrush communities (see Grimes [1990] and Isely [1998] for comprehensive maps of species distribution).

IUCN Red List category. We recommend that this species be listed as Least Concern (LC) under the IUCN Red List Categories and Criteria (IUCN, 2001) due to its widespread distribution and presence within several habitats across the Great Plains and Intermountain West.

2. Ladeania juncea (Eastwood) A. N. Egan & Reveal, comb. nov. Basionym: *Psoralea juncea* Eastwood, Proc. Calif. Acad. Sci., ser. 2, 6: 286. 1896 [1897]. *Psoralidium junceum* (Eastwood) Rydberg, N. Amer. Fl. 24: 17. 1919. TYPE. U.S.A. Utah: San Juan Co., Epsom Creek, 13 July 1895, *A. Eastwood 21* (lectotype, designated by Grimes, 1989: 21, CAS; duplicates, CAS, GH, MO, NY).

Although Grimes (in Barneby 1989: 21) termed the CAS specimen a "holotype"—as he did the Nuttall specimen of *Psoralea lanceolata* at PH, this is to be corrected to a lectotype. As Grimes pointed out (see also Grimes, 1990: 33), Eastwood made no reference

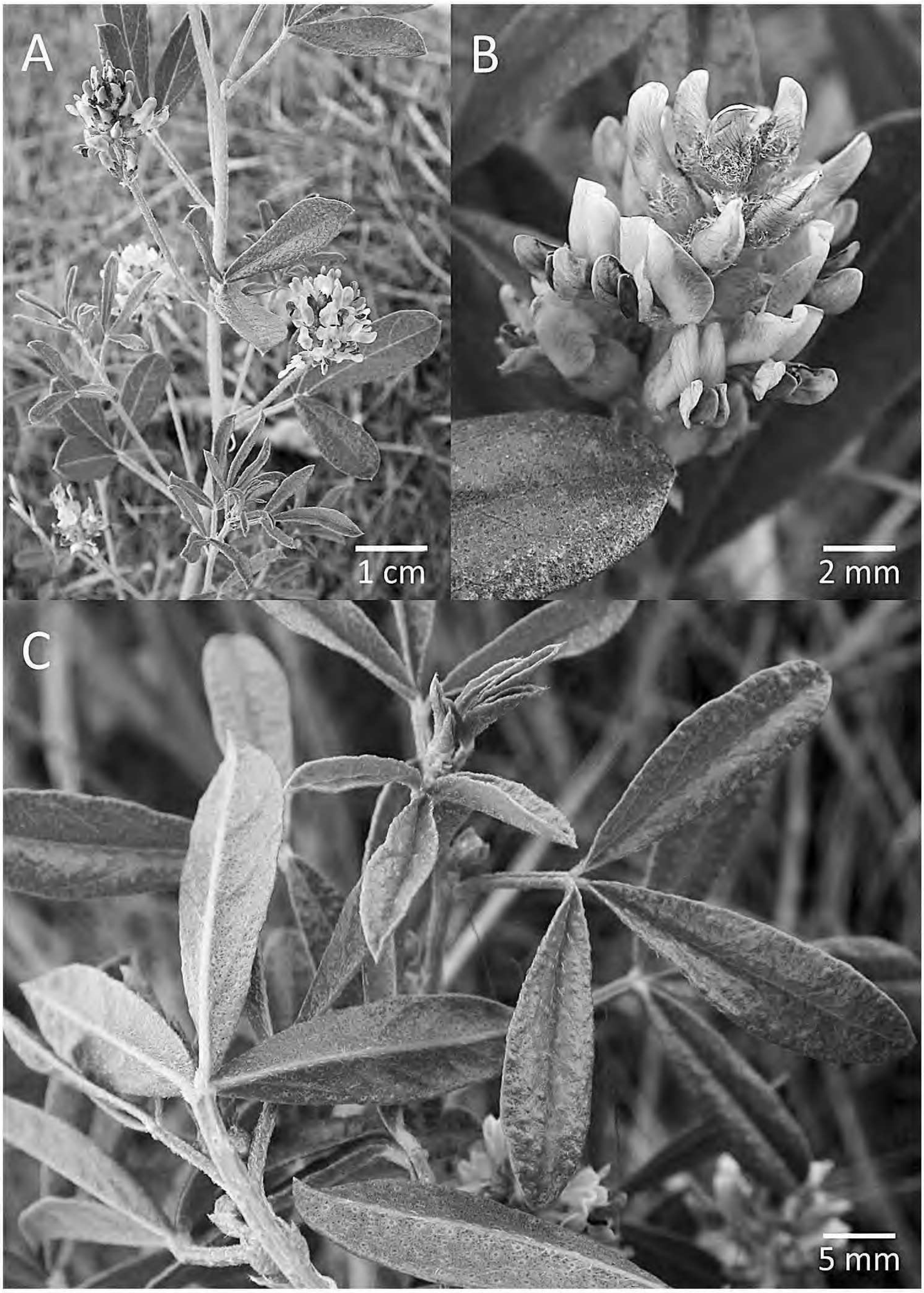

Figure 1. *Ladeania lanceolata* (Pursh) A. N. Egan & Reveal. —A. Axillary inflorescences with leaves and stem of plant. —B. A single inflorescence showing calyces and floral parts. —C. Leaves. Photographs used by permission of the photographer, Ben Legler. Photographs were taken of plants in Washington State and represent the morphological diversity found in the northwest portion of the species range.

to any collection in 1897. Nonetheless, her collection is original material and its individual specimens qualify as syntypes from which a lectotype is to be designated.

Distribution and habitat. The species is known only from sand dunes or semistabilized sandy substrates in desert shrub communities along the Colorado River and its tributaries in Kane and San

Juan counties of Utah, as well as Coconino County, Arizona (see Grimes [1990] and Isely [1998] for comprehensive maps of species distribution).

IUCN Red List category. We recommend that this species be listed as Vulnerable (VU) under the IUCN Red List Categories and Criteria (IUCN, 2001) based on the fact that its geographic range is estimated to be less than 20,000 km^2. *Ladeania juncea* is restricted to sandy habitats mainly within the southern portions of Kane and San Juan counties in Utah. A few reports of the species are listed from Garfield County, Utah, as well as a few from Coconino County, Arizona, where it is much more sparsely distributed. While this species may be locally abundant, fruit is set infrequently (Isely, 1998). In addition, over a portion of its range, the quality of its habitat is in decline due to infringement of grazing and recreational use.

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